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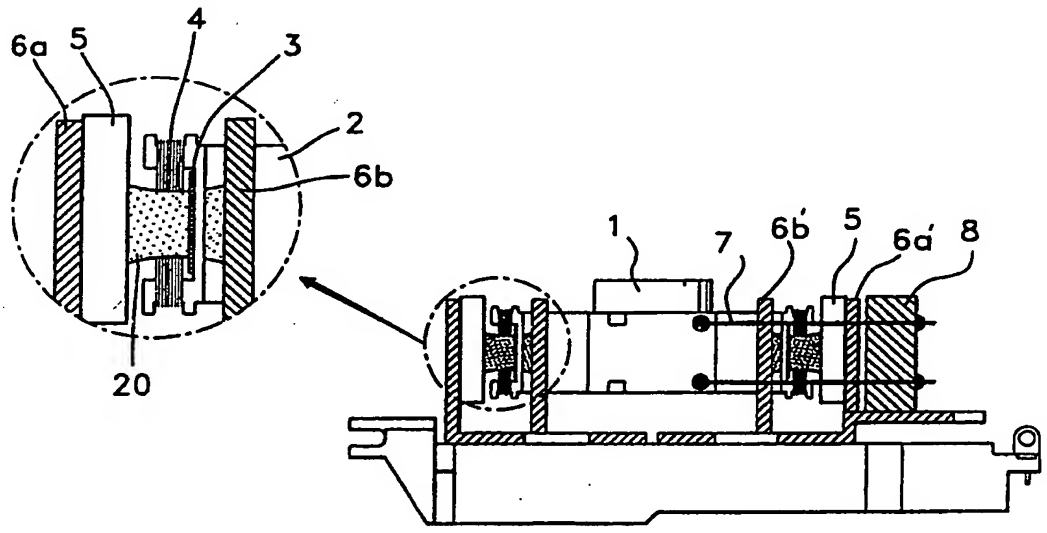
(54) Title: AN OPTICAL PICKUP ACTUATOR AND ITS DAMPING DEVICE



(57) Abstract

Disclosed is a damping device of an optical pickup actuator in which a damping fluid for removing a resonance of the actuator is put into a magnetic air gap formed between a magnet of a magnetic circuit unit of the optical pickup actuator and a lens holder facing the magnet to attach each other. The damping fluid includes ferrofluids having sub-micron sized particles in a carrier liquid.

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TITLE OF THE INVENTION

AN OPTICAL PICKUP ACTUATOR AND ITS DAMPING DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention.

The present invention relates to a damping device of an optical pickup actuator which is mounted at a compact disk player, etc. and detects recorded signals of a disk, and particularly to a damping device of an optical pickup actuator which reduces noticeably a resonance and is easily mounted.

Description of the Related Art

Conventionally, an optical pickup actuator is widely used in a variety of devices including CD players, laser disk players, CD-ROM drives, DVD-ROM drives, etc.

Referring to FIGs. 1 and 2, the structure of an optical pickup actuator assembly is roughly explained. At the surface of a main body 15 which is integrally molded, a pair of yokes 6 and 6' are fixed facing each other. At the other surface of the main body 15, a printed circuit board (PCB) 11 is mounted. At the yokes 6 and 6', protrusions 6a and 6b and 6a' and 6b' are formed respectively.

Moreover, at both sides on the surface of a lens holder 2 which is an integral bobbin/carrier assembly, through holes 12a and 12b are formed. Between the through holes 12a and 12b, an objective lens 1 is inserted and fixed. Moreover, a focusing coil 3 binds along the lateral surface of the lens holder 2. A tracking coil 4 binds both ends of the lens holder 2 perpendicularly to the focusing coil 3.

In the actuator having the above-described structure, the protrusions 6b and 6b' are inserted in the through holes 12a and 12b respectively. At the protrusions 6a and 6a' facing the tracking coil 4, magnets 5 and 5' are fixed. Moreover, the actuator is elastically fixed to a terminal 8 by four

wires 7 each of one end is fixed to a PCB 13 and maintains a predetermined magnetic air gap with magnets 5 and 5'.

When the disk is arrived, the lens holder 2 minutely moved in the focusing or tracking direction. At this time, the object lens 1 transmits laser beam and the actuator reads the signals stored in the disk.

In the optical pickup actuator, as a damping device for reducing the movement of the lens holder 2 in every directions, the wire 7 whose one end is fixed to the terminal 8 is used.

Conventionally, referring to FIG. 2, to obtain a damping effect on a mechanical resonance of the wire 7, a damper bond 10 made of silicon lubber of gel state is entered inside of the terminal 8 and the wire 7 is moved in every directions through the damper bond 10.

However, even in the case of using the damper bond 10, as shown in FIG. 4, it has a problem in that the mechanical resonance is generated in some frequencies.

The actuator still exhibits a strong mechanical resonance which affects its setting time and vibrational characteristics. This resonance can cause errors in reading information from the disk, particularly in high speed CD-ROM and DVD-ROM drives.

Moreover, in the case of increasing the amount of the damper bond 10 to reduce the resonance, the sensitivity is rather declined.

In the case of using the damper bond, it is difficult to put the damper bond into the terminal. In addition, since it requires a process of irradiating the ultraviolet and a separate damper bond putting hole is formed at the terminal, the process becomes complicated.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a damping device of an optical pickup actuator capable of reducing noticeably a resonance.

It is another object of the present invention to provide a damping device of an optical pickup actuator capable of being easily mounted.

According to one aspect of the present invention, a damping material for removing a resonance of the actuator is put into a magnetic air gap formed between a magnet of a magnetic circuit unit of the optical pickup actuator and a lens holder facing the magnet to attach each other.

According to another aspect of the present invention, a damping fluid for removing the resonance of the actuator is put into the magnetic air gap formed between the magnet of the magnetic circuit unit of the optical pickup actuator and the lens holder facing the magnet.

The damping fluid can includes ferrofluids having sub-micron sized particles in a carrier liquid. Preferably, the magnetic particles include Fe_3O_4.

Moreover, the ferrofluid has a predetermined viscosity.

According to another aspect of the present invention, the optical pickup actuator includes: a main body which is molded integrally; first and second yokes which are fixed at the surface of the main body apart from each other and each have a pair of protrusions perpendicularly to the surface of the main body facing each other; a lens holder which is movably inserted into the inner protrusions facing each other and bound by a focusing coil and a tracking coil perpendicularly formed each other, and has an objective lens at its surface; a magnet which is attached to the surface of the outer protrusions facing each other to face the lens holder; a wire which fixes the lens holder elastically to a terminal and applies an electrical signal to the focusing coil and the tracking coil; and a damping device in which a damping fluid is put into a gap between the magnet and the lens holder to attach each other.

Preferably, the damping fluid of the damping device is applied to gaps between the inner protrusions facing each other and the lens holder to be inserted into the inner

protrusions.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention, and many of the attendant advantages thereof, will become readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

FIG. 1 is a perspective view illustrating the structure of a conventional optical pickup actuator;

FIG. 2 is a sectional view illustrating a damping device of the optical pickup actuator shown in FIG. 1:

FIG. 3 is a sectional view illustrating a damping device of an optical pickup actuator according to the present invention;

FIG. 4 is a view illustrating the characteristic of an actuator of a conventional damping device;

FIGs. 5A and 5B are views illustrating the characteristic of an actuator according to a damping device of the present invention; and

FIGs. 6A and 6B are views illustrating the characteristic of an actuator employing a damper bond to the damping device of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The objects, characteristics and advantages of the above-described invention will be more clearly understood through the preferable embodiments referring to the attached drawings.

Referring to FIG. 3, in a magnetic air gap formed between magnets 5 and 5' and a focusing coil 3 of end side which are bound by a tracking coil 4, a damping fluid, i.e., a ferrofluid 20 is applied. A bobbin which is not illustrated is divided into two and the ferrofluid 20 is contacted to a part of a lens holder and the focusing coil 3 through a gap

between the divided bobbins. Preferably, the ferrofluid 20 is put between a protrusion 6b and the inner surface of a through hole 12a, and a protrusion 6b' and the inner surface of a through hole 12b.

The ferrofluid 20 is a ultra-stable colloidal suspensions in which magnetic particles are very stably scattered in the fluid. Even in the case that a large centrifugal force or magnetic force are applied to the ferrofluid 20, since the magnetic particles are not separated from the fluid, it is possible to accurately control the position. As the magnetic particle, Fe_3O_4 can be used. The ferrofluid has a predetermined viscosity. The fluid is retained in the magnetic field and its viscosity provides the desired mechanical resistance (damping) to the moving assembly.

Referring to FIG. 3, the wire 7 is directly fixed to the terminal 8 without using the damper bond.

According to the damping device of the present invention having the aforesaid structure, the lens holder on which a disk is mounted moves minutely to the focusing direction or the tracking direction and then stops, a flow is generated in every directions. At this time, by the damping operation of the ferrofluid 20, the actuator's setting time and the vibrational characteristic are improved. Access time is also improved.

According to the characteristic test of the actuator according to the damping device of the optical pickup actuator, as shown in FIGs. 5A and 5B, since the resonance reduces to an ideal value zero (0), the resonance point is not formed.

Moreover, since only the operation of filling the gap formed between the yokes and the magnet exposed outside with the ferrofluid without performing the process of putting the damper bond, the process is not complicated.

Since the heat generated from a lens holder when using the ferrofluid is transmitted to the yokes and then radiated to the outside, it can prevent the lens holder and the

objective lens from being melted due to the rise of heat in the focusing coil and the tracking coil.

In addition, the vibrational characteristic is noticeably improved by removing the minor vibration of the wire which supports the lens holder and a centering effect is realized by the characteristic of the ferrofluid itself.

As another embodiment, the conventional damper bond is applied to the damping device of the present invention, as shown in FIGs. 6A and 6B. Here, in the case that the ferrofluid is used when the damper bond is put, the resonance is greatly reduced and the damping effect which is noticeably improved can be obtained.

In the preferred embodiment of the invention, as the damping fluid, the ferrofluid is used. Also, it is possible to use another fluid or a material capable of obtaining the same damping effect.

While there have been illustrated and described what are considered to be preferred embodiments of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. In addition, many modifications may be made to adapt a particular situation to the teaching of the present invention without departing from the central scope thereof. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the present invention, but that the present invention includes all embodiments falling within the scope of the appended claims.

WHAT IS CLAIMED IS

1. A damping device of an optical pickup actuator, wherein a damping material for removing a resonance of the actuator is put into a magnetic air gap formed between a magnet of a magnetic circuit unit of said optical pickup actuator and a lens holder facing said magnet to attach each other.

2. A damping device of an optical pickup actuator, wherein a damping fluid for removing a resonance of the actuator is put into a magnetic air gap formed between a magnet of a magnetic circuit unit of said optical pickup actuator and a lens holder facing said magnet.

3. The damping device of Claim 2, wherein said damping fluid comprises ferrofluids having sub-micron sized particles in a carrier liquid.

4. The damping device of Claim 3, wherein said magnetic particles comprise Fe_3O_4.

5. The damping device of Claim 3, wherein said ferrofluid has a predetermined viscosity.

6. An optical pickup actuator comprising:

a main body which is molded integrally;

first and second yokes which are fixed at the surface of said main body apart from each other and each have a pair of protrusions perpendicularly to the surface of said main body facing each other;

a lens holder which is movably inserted into inner protrusions facing each other and bound by a focusing coil and a tracking coil perpendicularly formed each other, and has an objective lens at its surface;

a magnet which is attached to the surface of outer

protrusions facing each other to face said lens holder;

a wire which fixes said lens holder elastically to a terminal and applies an electrical signal to said focusing coil and the tracking coil; and

a damping device in which a damping fluid is put into a gap between said magnet and said lens holder to attach each other.

7. The optical pickup actuator of Claim 6, wherein said damping fluid includes ferrofluids.

8. The optical pickup actuator of Claim 7, wherein sub-micron sized particles are scattered in said ferrofluid.

9. The optical pickup actuator of Claim 7, wherein said magnetic particles comprise Fe_3O_4.

10. The damping device of Claim 7, wherein said ferrofluid has a predetermined viscosity.

11. The damping device of Claim 6, wherein the damping fluid of said damping device is further applied to gaps between said inner protrusions facing each other and said lens holder to be inserted into said inner protrusions.

12. The damping device of Claim 6, wherein said wire is fixed to said terminal through a damper bond.

FIG1

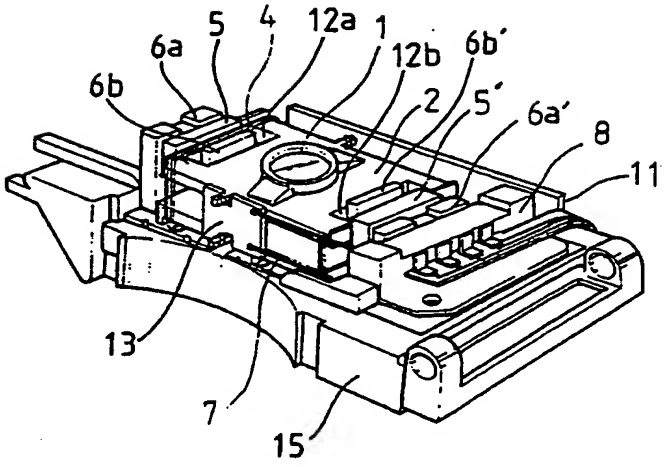


FIG2

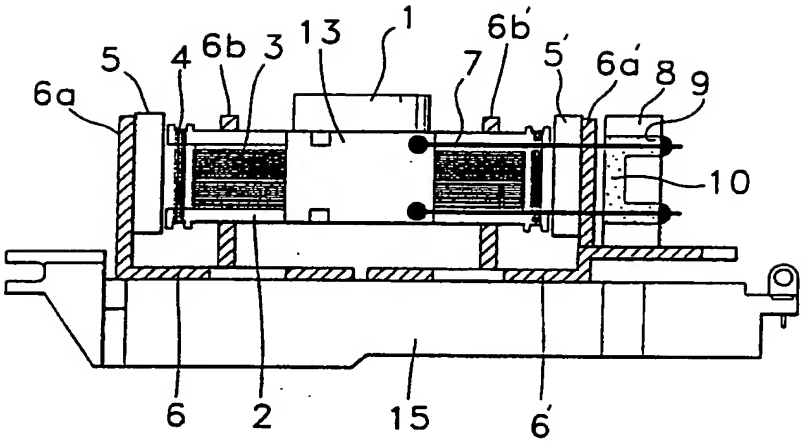


FIG3

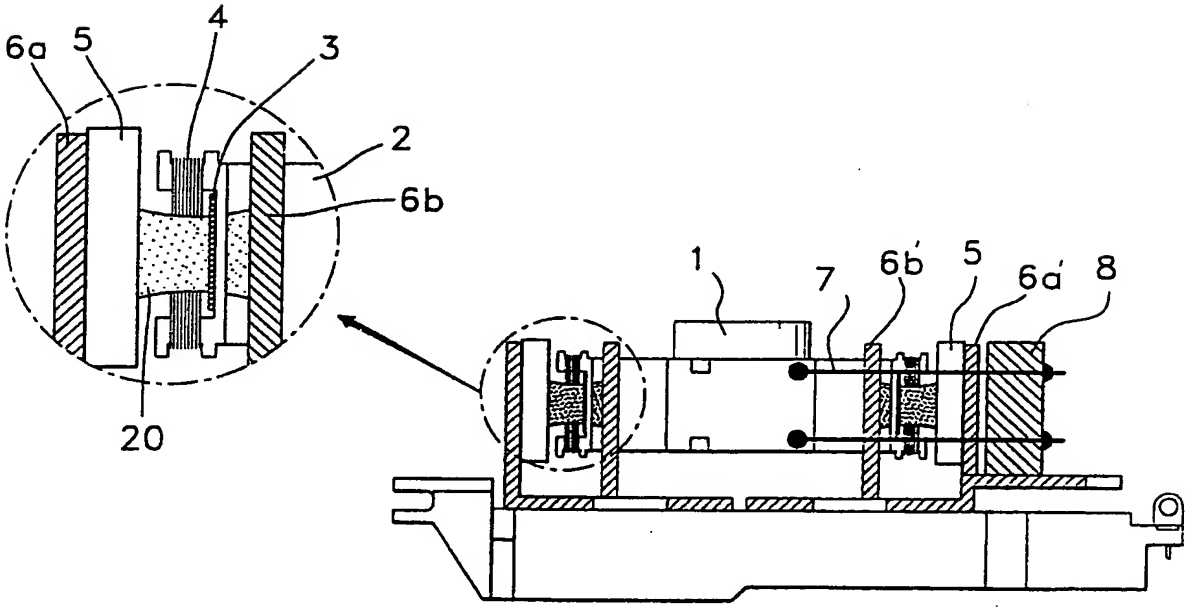


FIG4

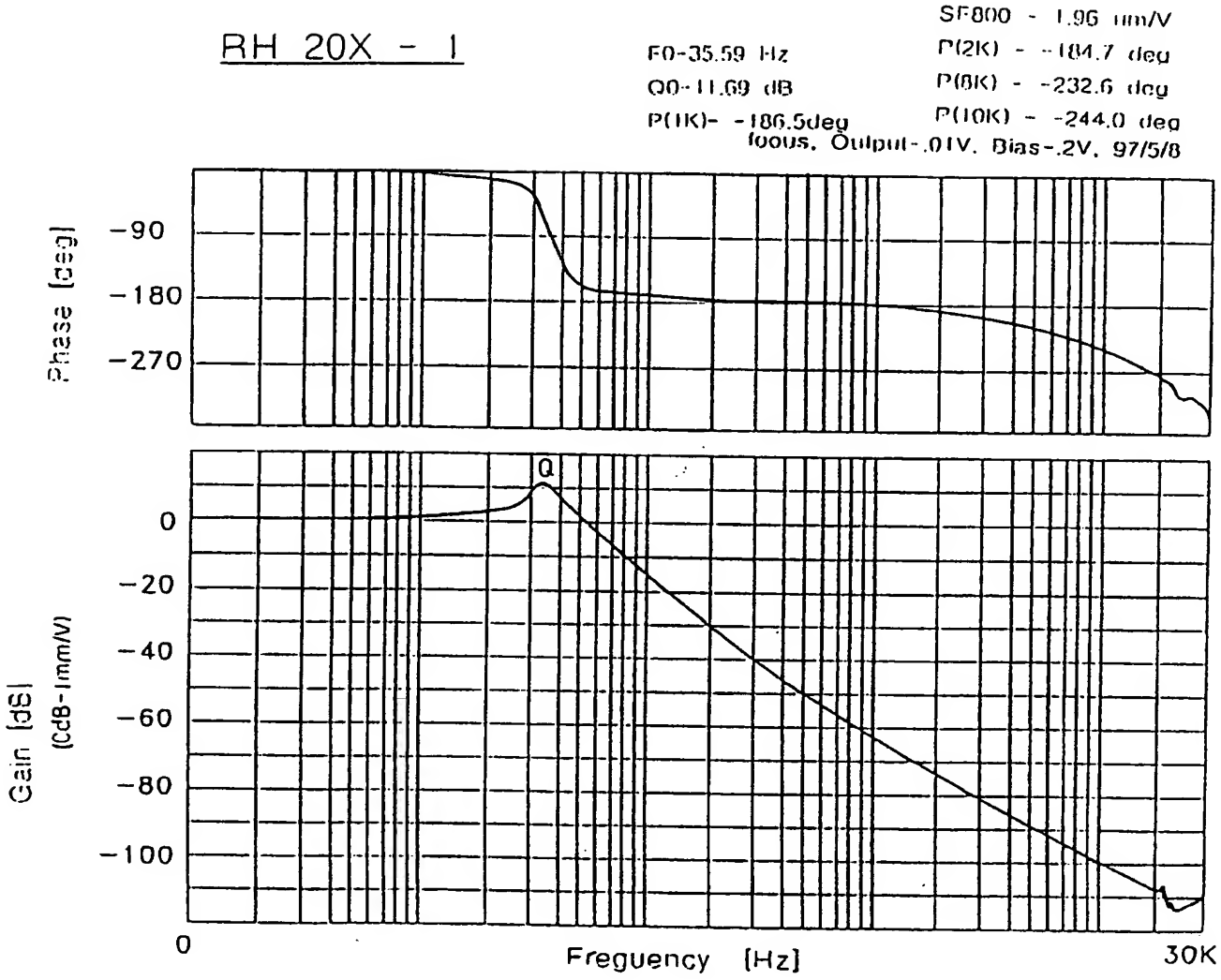

RH 20X - 1
F0-35.59 Hz
Q0-11.69 dB
P(1K)- -186.5deg
SF800 - 1.96 nm/V
P(2K) - -184.7 deg
P(8K) - -232.6 deg
P(10K) - -244.0 deg
focus, Output-.01V, Bias-.2V, 97/5/8
Phase [deg]
-90
-180
-270
Q
0
-20
-40
-60
-80
-100
Gain [dB]
(0dB-1mm/V)
0
Freguency [Hz]
30K

FIG5A

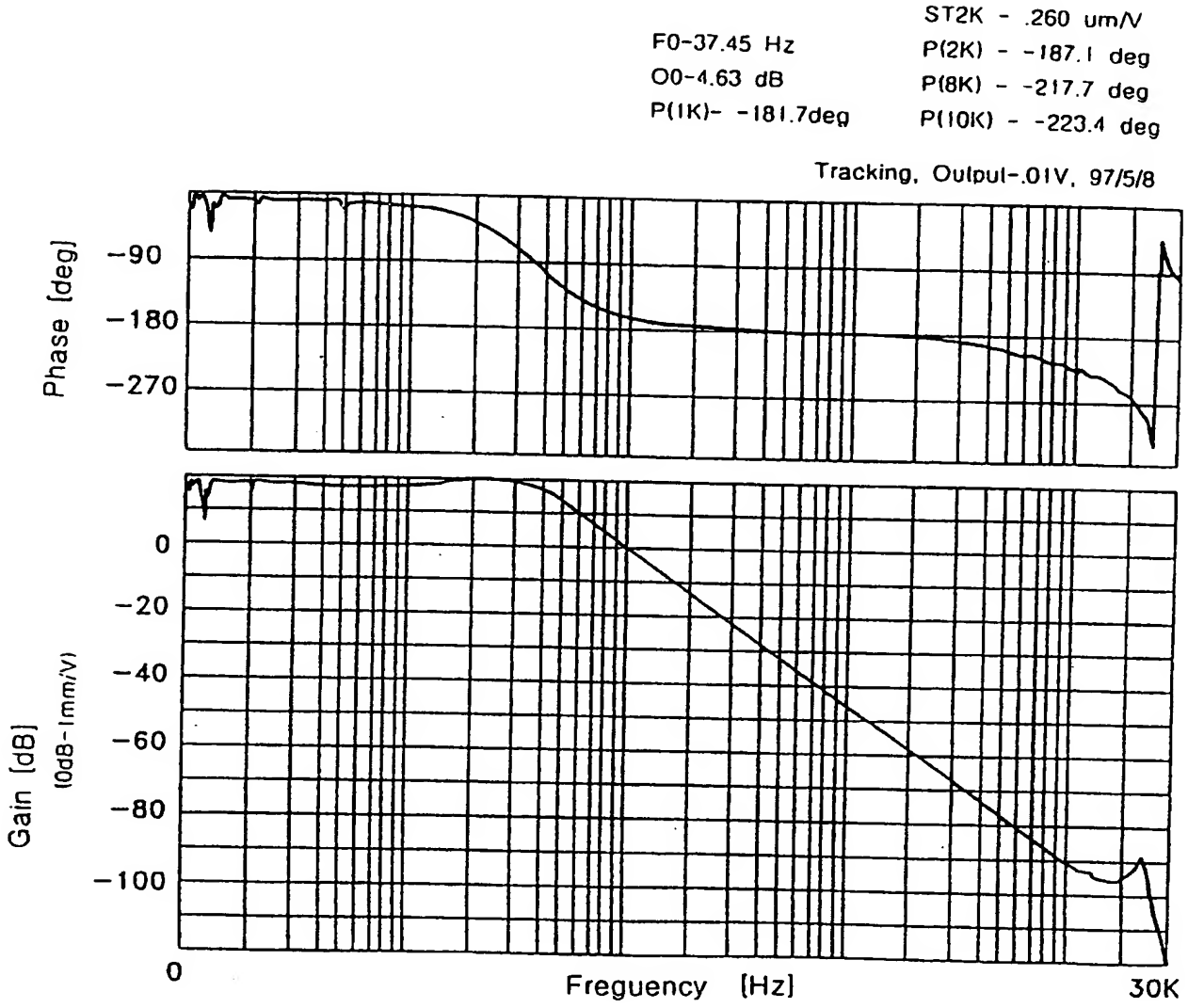

F0-37.45 Hz
O0-4.63 dB
P(1K)- -181.7deg
ST2K - .260 um/V
P(2K) - -187.1 deg
P(8K) - -217.7 deg
P(10K) - -223.4 deg
Tracking, Output-.01V, 97/5/8
Phase [deg]
-90
-180
-270
Gain [dB]
(0dB-1mm/V)
0
-20
-40
-60
-80
-100
0
Freguency [Hz]
30K

FIG5B

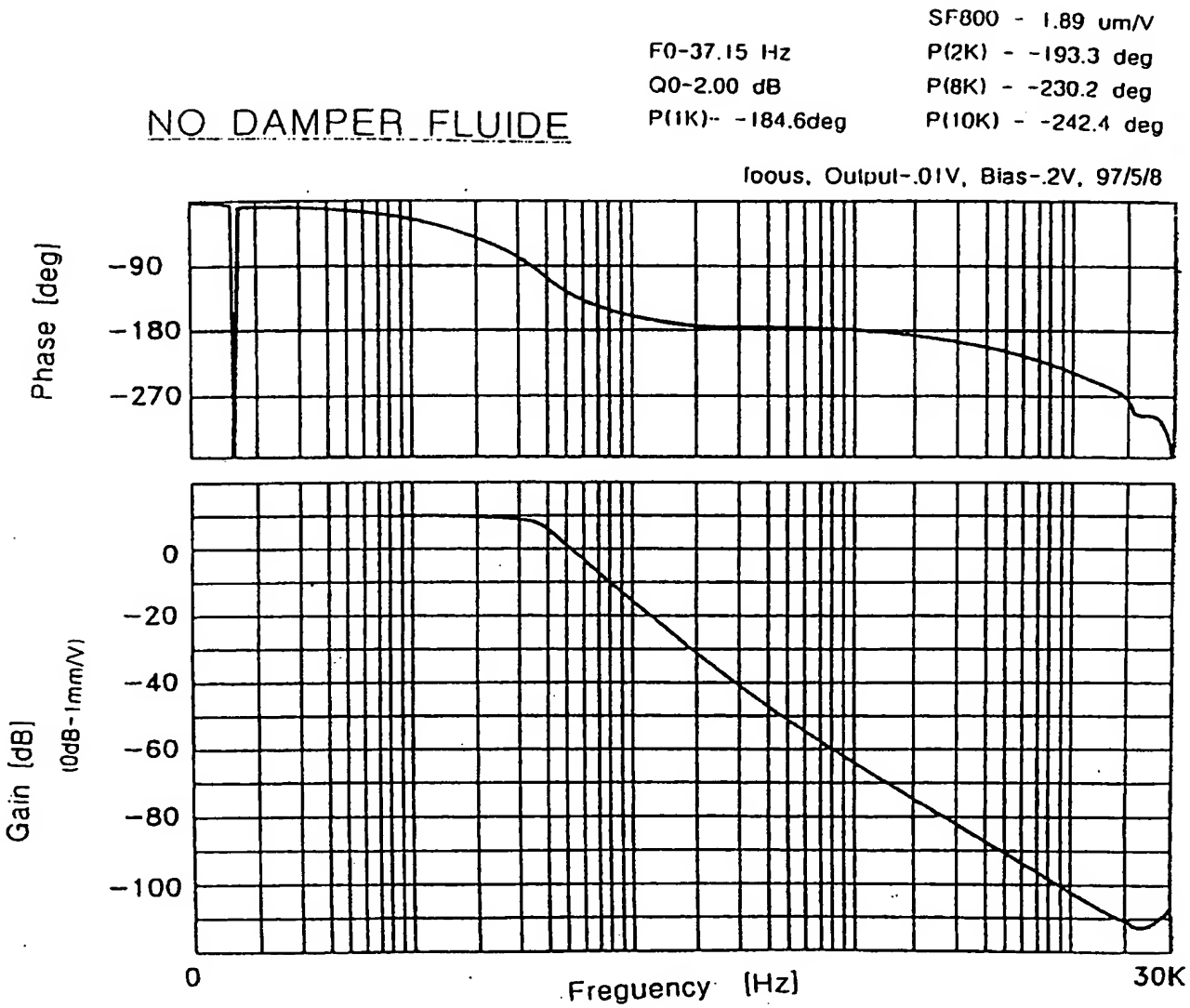

SF800 - 1.89 um/V
F0-37.15 Hz
P(2K) - -193.3 deg
Q0-2.00 dB
P(8K) - -230.2 deg
P(1K)- -184.6deg
P(10K) - -242.4 deg
NO DAMPER FLUIDE
foous, Output-.01V, Bias-.2V, 97/5/8
Phase [deg]
-90
-180
-270
Gain [dB]
(0dB-1mm/V)
0
-20
-40
-60
-80
-100
0
Freguency [Hz]
30K

FIG6A

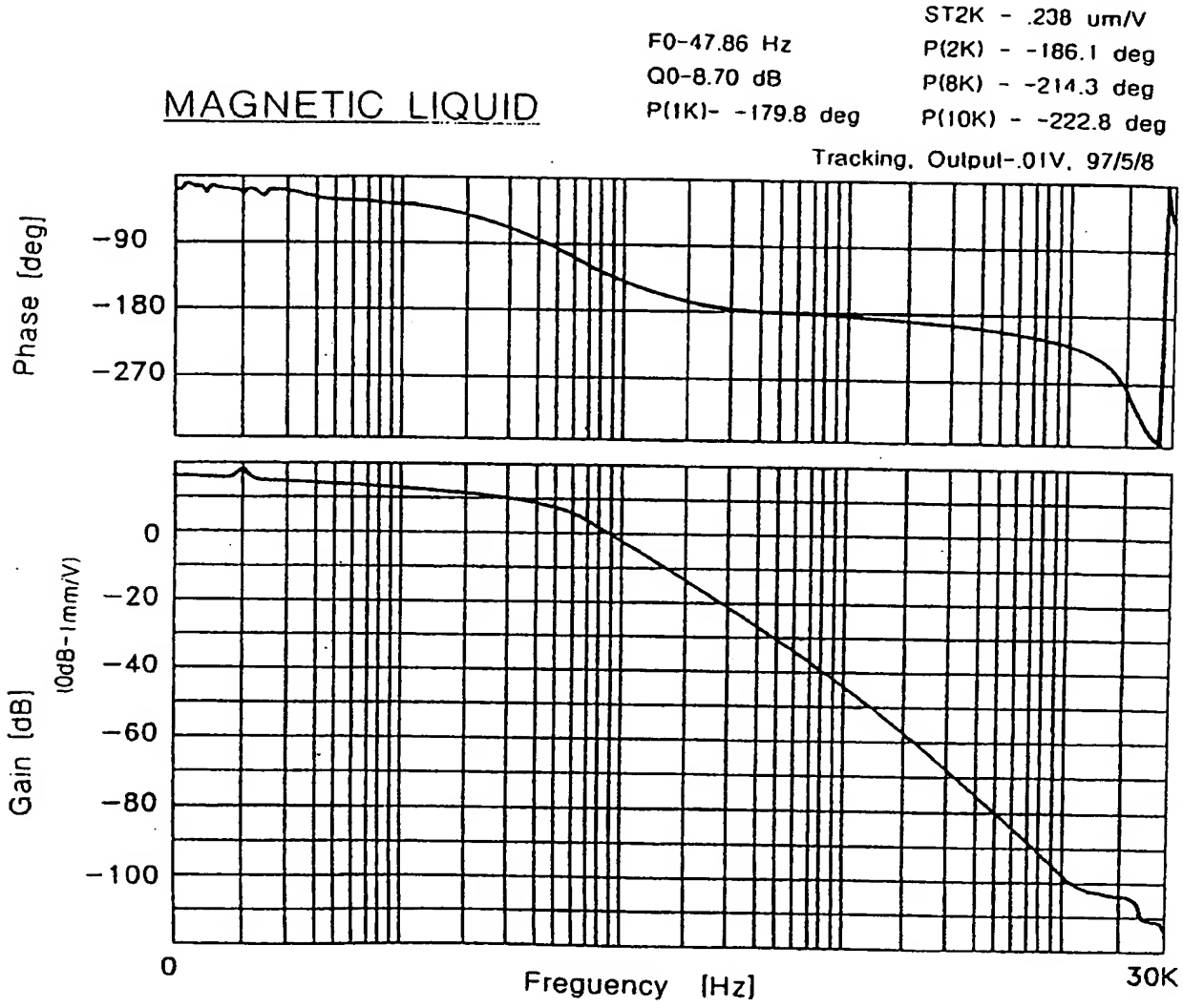
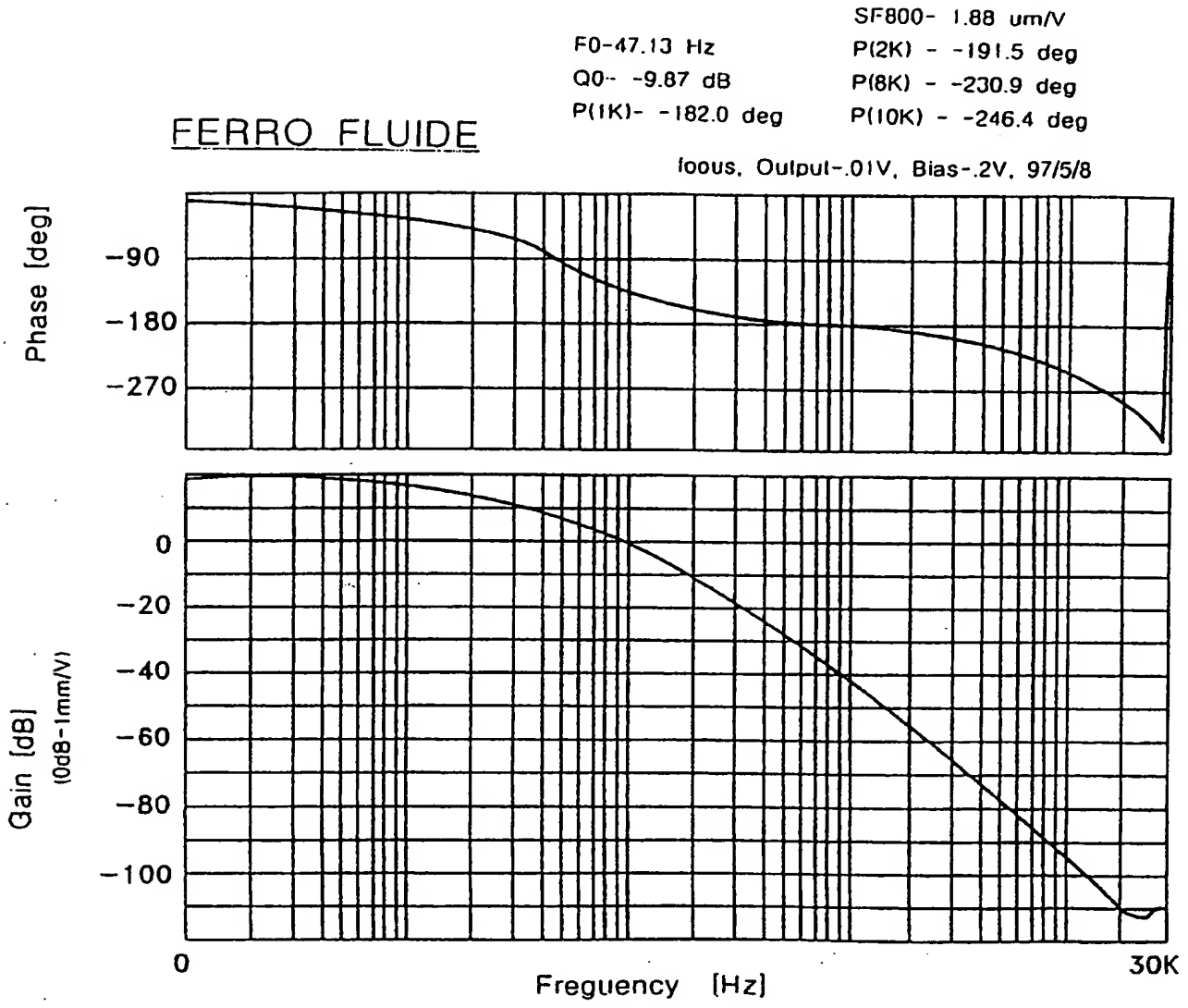

MAGNETIC LIQUID
F0-47.86 Hz
Q0-8.70 dB
P(1K)- -179.8 deg
ST2K - .238 um/V
P(2K) - -186.1 deg
P(8K) - -214.3 deg
P(10K) - -222.8 deg
Tracking, Output-.01V, 97/5/8
Phase [deg]
-90
-180
-270
Gain [dB]
(0dB-1mm/V)
0
-20
-40
-60
-80
-100
0
Freguency [Hz]
30K

FIG6B


SF800- 1.88 um/V
F0-47.13 Hz
P(2K) - -191.5 deg
Q0- -9.87 dB
P(8K) - -230.9 deg
P(1K)- -182.0 deg
P(10K) - -246.4 deg
FERRO FLUIDE
focus, Output-.01V, Bias-.2V, 97/5/8
Phase [deg]
-90
-180
-270
0
-20
-40
-60
-80
-100
Gain [dB]
(0dB-1mm/V)
0
30K
Freguency [Hz]

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 98/00108

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: G 11 B 7/09, 7/095, 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 735 526 A1 (DAEWOO ELECTRONICS CO., LTD.) 02 October 1996 (02.10.96), abstract; fig.4,5; claim 1.	1-12
A	Patent Abstracts of Japan, Vol.97, No.3, 1997, JP 08-306058 A (MITSUMI ELECTRIC CO., LTD.).	1-12
A	Patent Abstracts of Japan, Vol.96, No.10, 1996, JP 08-147734 A (SONY CORP.).	1

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Date of the actual completion of the international search	Date of mailing of the international search report
19 June 1998 (19.06.98)	30 June 1998 (30.06.98)
Name and mailing address of the ISA/ AT AUSTRIAN PATENT OFFICE Kohlmarkt 8-10 A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Berger Telephone No. 1/53424/453

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT
Information on patent family members

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In Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
EP A1 735526	02-10-96	CN A 1139264 EP B1 735526 JP A2 8329504	01-01-97 20-05-98 13-12-96

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